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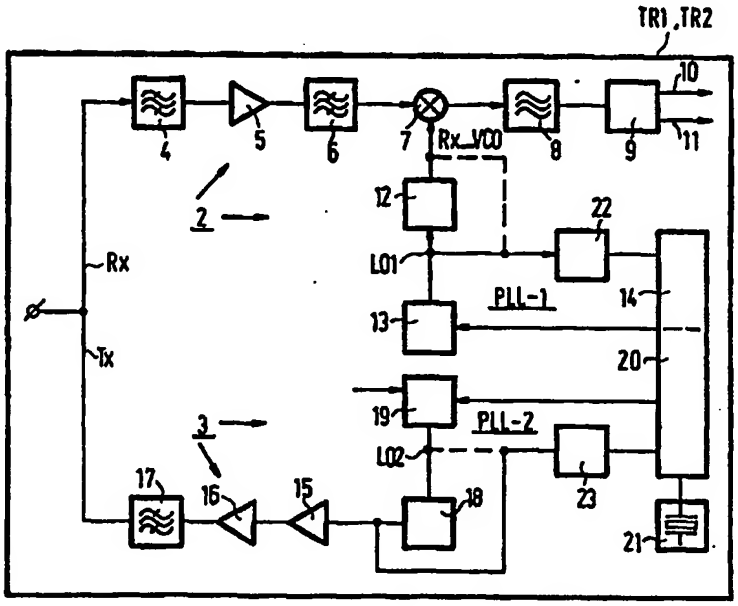
(54) Title: A TELECOMMUNICATION SYSTEM, AND A FIRST STATION, A SECOND STATION, AND A TRANSCEIVER FOR USE IN SUCH A SYSTEM

(57) Abstract

Known are telecommunication systems (1) such as cordless telephony systems as a CT1 or CT1+ system with a small separation between transmit and receive frequencies. When in such systems (1) transceivers are applied with so-called dual frequency synthesizers (14, 20) in a single package for the respective receiver branch (2) and transmitter branch (3), cross talk via the synthesizer package occurs between the receiver branch (2) and the transmitter branch (3). As authorities such as the German FTZ or the Dutch CEPT, or the like, specify maximum receiver spurious responses and transmitter spurious emissions, such cross talk has to be suppressed. It is proposed to put respective low pass and high pass filters (22, 23) for suppressing these spurious signals in the sneaky paths from the transmitter branch (3), through the dual frequency synthesizer (20, 14), and the receiver branch (2), and vice versa.



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"A telecommunication system, and a first station, a second station, and a transceiver for use in such a system"

The present invention relates to a telecommunication system comprising a first station with at least a first transceiver, and at least one second station with at least a second transceiver, the first and second station being arranged for radio communication with each other, in which system at least one transceiver comprises a receiver branch with a first phase-lock-loop for providing a first local oscillator signal, and a transmitter branch with a second phase-lock-loop for providing a second local oscillator signal, the first and the second phase-lock-loop comprising a first and a second synthesizer, respectively, which are galvanically coupled with each other. Such a system can be a cordless telephone system, a cellular telephone system, or any system in which transceivers communicate with each other by radio.

The present invention further relates to a first or a second station for use in such a system.

The present invention further relates to a transceiver for use in such a system.

A system of this kind is well-known as a cordless telephone system, such as a system according to the CT1 or CT1$^+$ Standard or any other standard. The application of galvanically coupled synthesizers in a transceiver is known from a Philips Semiconductors Application Note for an Integrated Circuit of type UMA1015M, "Low-power dual frequency synthesizer for radio communications", June 1993, version 2.1 for Cordless telephone or Hand-held mobile radio, or the like. A problem in a transceiver applying such an IC is interference of the transmitter branch with the receiver branch, i.e. a transmitter signal may not be present in the spectrum of the local oscillator signal in the receiver branch. Such a problem is the more severe when the transmit and receive frequency are relatively close to each other, such as in the CT1 system or CT1$^+$ system. In the German FTZ Regulation FTZ 1-TR2, or in the Dutch CEPT T/R 24-03 Regulation, regulations with regard to such so-called receiver spurious responses are given.

It is an object of the present invention to provide a telecommunication system of the above kind in which transceivers fulfil the requirements of Authorities as to receiver spurious responses.

To this end telecommunication system according to the present invention is characterised in that the receiver branch comprises a first frequency multiplier arrangement for multiplying the first local oscillator signal by a first integer greater than one, an output of the first frequency multiplier arrangement being coupled to an rf-path of the receiver branch, and in that at least one of the phase-locked loops in one of the branches comprises a filter for the suppression of spurious signals from the other branch. It is achieved that disturbing signals from the transmitter branch through the second and the first synthesizer to the receiver branch are suppressed to a great extent. As mainly signal leakage occurs via the IC package, pins, and bonds, the filter according to the present invention preferably may not be integrated within the synthesizer package.

In embodiments of the system, the filter is a low pass filter coupled between an input of the first frequency multiplier arrangement and the synthesizer or is a high pass filter coupled between the output of the first frequency arrangement and the first synthesizer.

In an embodiment of a telecommunication system according to the present invention, the transmitter branch comprises a second frequency multiplier arrangement for multiplying the second local oscillator signal by a second integer value greater than one, an output of the second frequency multiplier arrangement being coupled to an rf-path of the transmitter branch, and wherein a second high pass filter is coupled between the output of the second frequency multiplier arrangement and the second synthesizer, when the first low pass filter is present, or a second low pass filter is coupled between an input of the second frequency multiplier arrangement and the second synthesizer, when the first high pass filter is present. It is achieved that disturbing signals from the receiver branch through the first and the second synthesizer to the transmitter path are suppressed to a great extent, thereby fulfilling requirements of Authorities as to transmitter spurious emissions. It is to be noticed that the problem of suppressing transmitter spurious emissions is less severe than the problem of suppressing receiver spurious responses, because in the transmitter branch usually a transmit filter is present in the rf-path, which transmit filter also filters signals outside the transmission band.

Instead of coupled phase-lock-loops, according to the present invention, these PLLs may be replaced by frequency-lock loops.

In an embodiment of the present invention, the first multiplier arrangement may be located in the transmitter branch, and the first low pass filter or high pass filter may be located at corresponding locations in the first phase-lock-loop.

The present invention will now be described, by way of example, with reference to the accompanying drawings, wherein

Fig. 1 shows a telecommunication system according to the present invention,

Fig. 2 shows a transceiver for use in a telecommunication system according to the present invention, and

Fig. 3 shows frequencies for a first and a second station in a system according to the present invention.

Throughout the figures the same reference numerals are used for the same features.

Fig. 1 shows a telecommunication system 1 according to the present invention, which can be a cordless telephony system. The system 1 comprises a first station BS, which is a cordless telephony base station e.g. in a CT1 or a CT1$^+$ system, with a first transceiver TR1. The first station BS is coupled to the Public Switched Telephone Network PSTN. The system 1 further comprises a second station HS1, which is a cordless telephony handset, and which comprises a second transceiver TR2. Further shown is another second station as a cordless handset HS2 with a transceiver TR3. Preferably, all transceivers in the system 1 are transceivers as according to the present invention. For a more detailed description of a cordless telephone system, referred is to the numerous handbooks with respect to such systems. The stations are arranged for duplex radio communications with each other.

Fig. 2 shows the transceivers TR1, TR2 for use in the first station BS and the second station HS1 in the telecommunication system 1 according to the present invention. Shown are parts of the transceiver as relevant to the present invention. The transceiver TR1 comprises a receiver branch 2 and a transmitter branch 3, which are coupled to transmission means for receiving and transmitting radio waves (not shown in detail). The receiver branch 2 successively comprises a bandfilter 4, an rf-amplifier 5 (radio frequency), a bandfilter 6, a

mixer 7, an IF-filter 8 (Intermediate Frequency), and a demodulator 9, e.g. an FM-demodulator, providing an lf-signal (low frequency) and an RSSI signal (Received Signal Strength Indication). The receiver branch 2 further comprises a first phase-lock-loop PLL-1 for providing a first local oscillator signal LO1 to the mixer 7, via a first frequency multiplier arrangement 12 for multiplying the first local oscillator signal by a first integer greater than one, preferably by two. The use of a sub-harmonic is necessary for getting the required suppression of receiver spurious responses. Too high a multiplication factor would render the loop response of the phase-lock-loop too slow, because of a lower cut-off frequency of a PLL loop filter (not shown), which would be undesirable for cordless telephony in which a lot of different channels have to be scanned. Further shown are signals Rx and Tx at a transceiver front end, and a receiver VCO-signal Rx_VCO after the first frequency multiplier arrangement 12. The phase-lock-loop PLL-1 comprises a receive voltage controlled oscillator 13, which is coupled to a first synthesizer 14. The transmitter branch 3 comprises a pre-amplifier 15, a power amplifier 16, and a transmit filter 17. The transmitter branch 3 further comprises a second phase-lock-loop PLL-2 for providing a second local oscillator signal LO2 to an rf-path of the transmitter branch 3 via a second frequency multiplier arrangement 18. The phase-lock-loop PLL-2 comprises a transmit voltage controlled oscillator 19, which is coupled to a second synthesizer 20. In an embodiment of the present invention, the second frequency multiplier arrangement 18 may be dispensed with, but also applying the second frequency multiplier arrangement 18 has the advantage that the oscillator 19 can be less expensive because it operates at a lower frequency. The first and the second synthesizer 14 and 20 are galvanically coupled, and are controlled by a reference crystal oscillator 21. Such a so-called dual synthesizer can be said IC of type UMA1015M. According to the present invention, the first phase-lock-loop PLL-1 comprises a first filter 22 for suppressing said receiver spurious response, and the second phase-lock-loop PLL-2 comprises a second filter 23 for suppressing said transmitter spurious emissions. In an embodiment, indicated with solid lines, the first filter 22 is a first low pass filter coupled between the oscillator 13 and the synthesizer 14, and the second filter 23 is a second high pass filter coupled between an output of the frequency multiplier 18 and the synthesizer 20. In another embodiment, indicated with dashed lines, the first filter 22 is a first high pass filter coupled between the mixer 7 and the synthesizer 14, and the second filter 23 is a low pass filter coupled between the oscillator 19 and the synthesizer 20. Low pass filters and high pass filters as such are well-known in the art, and are not described in detail here. A low pass filter according to the present invention has to be dimensioned such that it blocks the

spurious higher frequency signal and passes PLL frequencies. With respect to a high pass filter according to the present invention, the opposite holds.

Fig. 3 shows frequencies for the first and second stations BS, and HS1 and HS2 in the system 1 according to the present invention. Shown are frequencies in MHz for the various signals described, i.e. Tx, Rx, and Rx_VCO, for a CT1 system and a $CT1^+$ system.

CLAIMS:

1. A telecommunication system (1) comprising a first station (BS) with at least a first transceiver (TR1), and at least one second station (HS1) with at least a second transceiver (TR2), the first and second station (BS, HS1) being arranged for radio communication with each other, in which system (1) at least one transceiver (TR1, TR2, TR3) comprises a receiver branch (2) with a first phase-lock-loop (PLL-1) for providing a first local oscillator signal (LO1), and a transmitter branch (3) with a second phase-lock-loop (PLL-2) for providing a second local oscillator signal (LO2), the first and the second phase-lock-loop (PLL-1, PLL-2) comprising a first and a second synthesizer (14, 20), respectively, which are coupled with each other, characterised in that the receiver branch (2) comprises a first frequency multiplier arrangement (12) for multiplying the first local oscillator signal (LO1) by a first integer greater than one, an output of the first frequency multiplier arrangement (12) being coupled to an rf-path of the receiver branch (2), and in that at least one of the phase-locked loops in one of the branches comprises a filter for the suppresion of spurious signals from the other branch.

2. A telecommunication system according to clam 1, wherein the filter is a low pass filter which is coupled between an input of the first frequency multiplier arrangement and the first synthesizer.

3. A telecommunication system according to claim 1, wherein the filter is a high pass filter which is coupled between the output of the first frequency multiplier arrangement and the first synthesizer.

4. A telecommunication system according to claims 1, 2 or 3, wherein the transmitter branch (3) comprises a second frequency multiplier arrangement (18) for multiplying the second local oscillator signal (LO2) by a second integer value greater than one, an output of the second frequency multiplier arrangement (18) being coupled to an rf-path of the transmitter branch (3), and wherein a second high pass filter (23) is coupled between the output of the second frequency multiplier arrangement (18) and the second synthesizer (20), when the first low pass filter (22) is present, or a second low pass filter is coupled between an input of the second frequency multiplier arrangement and the second synthesizer, when the first high pass filter is present.

5. A telecommunication system according to claim 1, modified in that the first frequency multiplier arrangement (12) is located in the transmitter branch, and the first low pass filter or high pass filter is located at corresponding locations in the first phase-lock-loop.

6. A first or a second station (BS, HS1) for use in a telecommunication system (1) according to claim 1 with a transceiver (TR1) comprising a receiver branch (2) with a first phase-lock-loop (PLL-1) for providing a first local oscillator signal (LO1), and a transmitter branch (3) with a second phase-lock-loop (PLL-2) for providing a second local oscillator signal (LO2), the first and the second phase-lock-loop (PLL-1, PLL-2) comprising a first and a second synthesizer (14, 20), respectively, which are galvanically coupled with each other, characterised in that the receiver branch (2) comprises a first frequency multiplier arrangement (12) for multiplying the first local oscillator signal (LO1) by a first integer greater than one, an output of the first frequency multiplier arrangement (12) being coupled to an rf-path of the receiver branch (2), and in that at least one of the phase-locked loops in one of the branches comprises a filter for the suppresion of spurious signals from the other branch.

7. A transceiver (TR1) comprising a receiver branch (2) with a first phase-lock-loop (PLL-1) for providing a first local oscillator signal (LO1), and a transmitter branch (3) with a second phase-lock-loop (PLL-2) for providing a second local oscillator signal (LO2), the first and the second phase-lock-loop (PLL-1, PLL-2) comprising a first and a second synthesizer (14, 20), respectively, which are galvanically coupled with each other, characterised in that the receiver branch (2) comprises a first frequency multiplier arrangement (12) for multiplying the first local oscillator signal (LO1) by a first integer greater than one, an output of the first frequency multiplier arrangement (12) being coupled to an rf-path of the receiver branch (2), and in that at least one of the phase-locked loops in one of the branches comprises a filter for the suppresion of spurious signals from the other branch.

8. A transceiver according to claim 5, wherein the transmitter branch (3) comprises a second frequency multiplier arrangement (18) for multiplying the second local oscillator signal (LO2) by a second integer value greater than one, an output of the second frequency multiplier arrangement (18) being coupled to an rf-path of the transmitter branch (3), and wherein a second high pass filter (23) is coupled between the output of the second frequency multiplier arrangement (18) and the second synthesizer (20), when the first low pass filter (22) is present, or a second low pass filter is coupled between an input of the

second frequency multiplier arrangement and the second synthesizer, when the first high pass filter is present.

9. A telecommunication system or a first station or a second station according to any of the previous claims, modified in that the first phase-lock-loop and the second phase-lock-loop are replaced by respective first and second frequency lock loops.

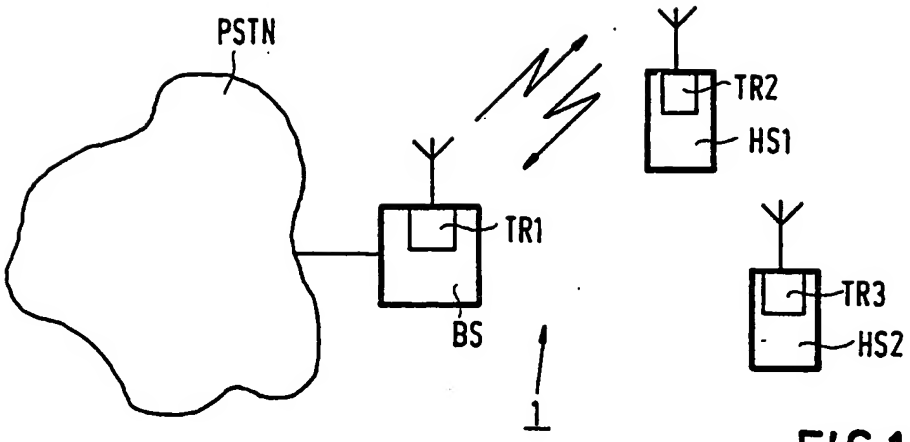

FIG.1

	BS			HS1 , HS2		
	Tx	Rx	Rx_VCO	Tx	Rx	Rx_VCO
CT1	959	914	856	914	959	1017
CT1+	931	886	828	886	931	989

FIG.3

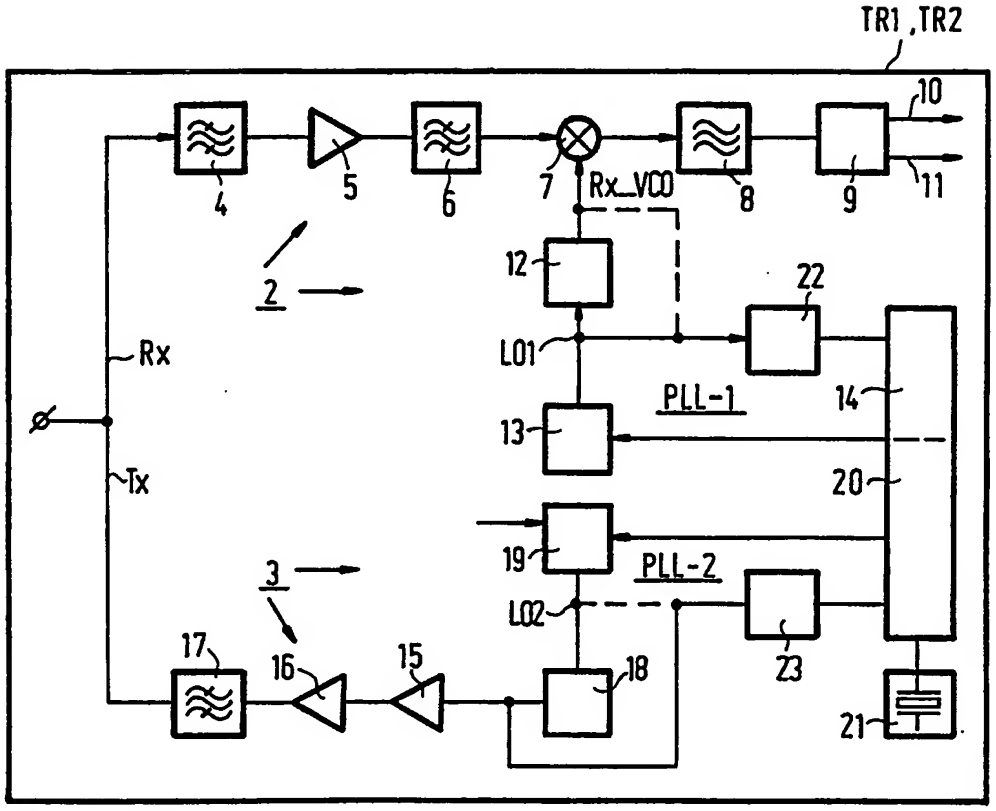
TR1 ,TR2
10
11
4
5
6
7
Rx_VCO
8
9
12
22
2
LO1
Rx
PLL-1
14
13
Tx
20
19
PLL-2
3
LO2
17
16
15
18
23
21

FIG.2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB 94/00355

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: H04B 1/40, H04B 1/10
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: H04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

ORBIT: WPIL, USPA, EPOQUE: PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US, A, 4086545 (TESHIROGI), 25 April 1978 (25.04.78), column 1, line 49 - column 2, line 2, figure 2	1-9
A	US, A, 4097805 (FUJII ET AL), 27 June 1978 (27.06.78), column 1, line 34 - line 47	1-9
A	GB, A, 2238193 (MURATA MANUFACTURING CO LTD), 22 May 1991 (22.05.91), figures 3,5, abstract	1-9

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
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INTERNATIONAL SEARCH REPORT

Information on patent family members

01/04/95

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A- 4086545	25/04/78	JP-C- 987161	21/02/80
		JP-A- 52122409	14/10/77
		JP-B- 54016366	21/06/79
US-A- 4097805	27/06/78	JP-C- 1025906	18/12/80
		JP-A- 52004105	13/01/77
		JP-B- 55018081	16/05/80
GB-A- 2238193	22/05/91	JP-A- 3139022	13/06/91